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Millisecond Pulsars at Gamma-Ray Energies: Fermi Detections and Implications

Alice K. Harding
NASA Goddard Space Flight Center

The Fermi Gamma-Ray Space Telescope has revolutionized the study of pulsar physics with the discovery of new populations of radio quiet and millisecond gamma-ray pulsars. The Fermi Large Area Telescope has so far discovered ~20 new gamma-ray millisecond pulsars (MSPs) by both folding at periods of known radio MSPs or by detecting them as gamma-ray sources that are followed up by radio pulsar searches. The second method has resulted in a phenomenally successful synergy, with ~30 new radio MSPs (to date) having been discovered at Fermi unidentified source locations and the gamma-ray pulsations having then been detected in a number of these using the radio timing solutions. Many of the newly discovered MSPs may be suitable for addition to the collection of very stable MSPs used for gravitational wave detection. Detection of such a large number of MSPs was surprising, given that most have relatively low spin-down luminosity and surface field strength. I will discuss their properties and the implications for pulsar particle acceleration and emission, as well as their potential contribution to gamma-ray backgrounds and Galactic cosmic rays.